From the INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

Received By ____

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

IMPORTANT NOTIFICATION

Date of mailing

(day/month/year)

22.08.2005

Applicant's or agent's file reference

38569/268117

International filing date (day/month/year)

Priority date (day/month/year)

PCT/US 03/25029

International application No.

08.08.2003

08.08.2003

Applicant

HONEYWELL INTERNATIONAL INC. et al.

- The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
- 2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
- 3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and malling address of the international preliminary examining authority:



European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 Authorized Officer

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Form PCT/PEA/416 (January 2004)

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 38569/268117	FOR FURTHER ACTION		of Transmittal of International amination Report (Form PCT/IPEA/41	16)	
International application No.	International filing date (day/mo	nth/year)	Priority date (day/month/year)		
PCT/US 03/25029	08.08.2003		08.08.2003		
International Patent Classification (IPC) or b	oth national classification and IPC		· · · · · · · · · · · · · · · · · · ·		
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Applicant					
HONEYWELL INTERNATIONAL IN	IC. et al.			.*	
1. This international preliminary exa	mination report has been prep	ared by this Inte	rnational Preliminary Examining		
Authority and is transmitted to the	applicant according to Article	36.	•		
2. This REPORT consists of a total	of 5 sheets, including this cov	er sheet.		•	
heen amended and are the	nied by ANNEXES, i.e. sheets basis for this report and/or she n 607 of the Administrative Ins	ets containing re	on, claims and/or drawings which ectifications made before this Au he PCT).	have thority	
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3. This report contains indications re	lating to the following items:				
3. This report contains indications re	saling to the following items.				
I ☑ Basis of the opinion					
II ☐ Priority					
III Non-establishment of	opinion with regard to novelty,	inventive step a	and industrial applicability		
IV Lack of unity of invent	ion	•			
V 🛭 Reasoned statement citations and explanat	under Rule 66.2(a)(ii) with regations supporting such statemer	ard to novelty, in nt	ventive step or industrial applical	bility;	
VI Certain documents cit	ed		•		
VII Certain defects in the	international application	• .			
	on the international application	r i i jir			
	Dota	of completion of th	is report		
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Form PCT/PEA/409 (Cover Sheet) (January 2004)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US 03/25029

I. Basis of the report

Description, Pages

IAP20 Residentiation 3 0 JAN 2006

1. With regard to the **elements** of the international application (Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)):

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	Cla	ims, Numbers					•	
	1-1	9	received on 22.06	6.2005 with le	tter of 22.06.20	05	٠٠.	
	Dra	awings, Sheets						
	1/10	0-10/10	as originally filed	•	·			
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	The	ese elements were available	or furnished to this	Authority in the	ne following lan	guage: , ı	which is:	
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		the language of publication	n of the international	application (under Rule 48.3	3(b)).		
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4.	The	e amendments have resulte	d in the cancellation	of:			٠.	
		the description, page	s:					
		the claims, Nos.		•	•			
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Form PCT/IPEA/409 (January 2004)

5. 🗆	This report has been established as if (some of) the amendments had not been made, since they h	ave
	been considered to go beyond the disclosure as filed (Rule 70.2(c)).	•

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: No:	Claims	1-19
Inventive step (IS)	Yes: No:	Claims Claims	1-19
Industrial applicability (IA)	Yes: No:	Claims Claims	1-19

2. Citations and explanations

see separate sheet

IAP20 Rec'd PCT/FTO 30 JAN 2006

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- Reference is made to the following documents:
 - D1: PATENT ABSTRACTS OF JAPAN vol. 2002, no. 04, 4 August 2002 (2002-08-04) & JP 2001 355453 A (TAKEMOTO SHIGETO), 26 December 2001 (2001-12-26)
 - D2: GB-A-2 244 312 (MOTOREN TURBINEN UNION) 27 November 1991 (1991-
 - D3: GB-A-2 163 483 (SOLEX) 26 February 1986 (1986-02-26)
- The document D3, which is regarded as being an important document, shows a system for supplying compressed air to a combustion engine whereby a recirculation line is arranged to recirculate a portion of the compressed air to the compressor air inlet. A bypass control valve is provided in the recirculation passage to control flow through the recirculation passage.

The subject-matter of claims 1 and 16 differs from this known prior art in that the recirculation valve is open when the engine is operating below a threshold engine speed and closed when the engine is operating above said threshold engine speed.

The subject matter of claims 1 and 16 is new in sens of Article 33(2) PCT.

In D3 the recirculation valve is controlled so that the pressure would be high when the engine load demand is high and would be low when the engine load is light. The recirculation valve is therefore closed when the engine load demand is high and open when the engine load is light.

In D1, which is also considered an important document, the recirculation valve is open when the compressor discharge pressure is above a predetermined threshold. this occurs however regardless of speed.

The object of the present invention is to avoid compressor surge.

The solution proposed in claims 1 and 16 of the present application involves an inventive step. The control of the recirculation valve as described in the claims is in fact neither described nor suggested by the documents cited in the search report.

The invention is industrial applicable.

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A system (10) for supplying compressed air to an internal combustion engine (14) so as to boost power output by the engine, said system comprising:

a compressor (11) having a rotary compression device (30) positioned in a housing (24) defining an air inlet (23) and a compressed air outlet (32), wherein the air inlet (23) is configured to supply inlet air to the rotary compression device, wherein the rotary compression device is configured to compress the inlet air and wherein the compressed air outlet is configured to allow the compressed air to exit the housing for supply to an intake of the engine;

a recirculation line (18) arranged to recirculate a portion of the compressed air discharged from the compressed air outlet (32) back to the compressor air inlet (23);

a recirculation valve (22) disposed in the recirculation line (18) and operable to control rate of flow through the recirculation line, the recirculation valve being controllable via control signals;

a programmed controller (21) in communication with the recirculation valve (22) and programmed to send control signals to the recirculation valve to open the recirculation valve so as to recirculate compressed air through the recirculation line (18) to the compressor air inlet (23) when the engine is operating below a threshold engine speed, and to maintain the recirculation valve closed so as to prevent recirculation when the engine is operating above said threshold engine speed; and

an air cooling device (50) connected in fluid communication with the recirculation line (18) and operable to cool the recirculated air upstream of the compressor air inlet (23), wherein the cooled air from the recirculation line is combined with the inlet air upstream of the compressor air inlet, the cooled recirculated air reducing occurrence of compressor surge.

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Empf.nr. 223 P.009

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- 2. The system of Claim 1, wherein the controller (21) is programmed to control an amount of the valve opening (RVO) of the recirculation valve (22) as a function of the engine speed and the outlet air pressure.
- 3. The system of Claim 2, wherein the controller (21) is programmed to control the amount of valve opening (RVO) according to the equation:

RVO = A/Ne + B/P2C

wherein A and B are predetermined constants, Ne is the engine speed and P2C is the outlet air pressure.

- 4. The system of Claim 1, further comprising a compressor discharge line (13) connecting the engine intake and the compressor outlet (32), wherein a first end (27) of the recirculation line (18) is connected to the compressor discharge line (13) and wherein the air cooling device (50) is connected in fluid communication with the compressor discharge line (13) upstream of the recirculation line (18) first end and compressor discharge line (13) connection.
- 5. The system of Claim 1, further comprising a compressor inlet line (12) connected to the compressor air inlet (23), wherein a second end (28) of the recirculation line (18) is connected to the compressor inlet line (12).
- 6. The system of Claim 5, further comprising a mixing device (20) connected to the recirculation line (18) and the compressor inlet line (12) and operable for mixing cooled, recirculated air from the recirculation line with inlet air from the compressor inlet line.
- 7. The system of Claim 6, wherein the mixing device (20) is an air cleaner.
- 8. The system of Claim 6, further comprising an air cleaner (49) connected to the compressor inlet line (12) upstream of the mixing device (20).
- 9. The system of Claim 1, further comprising a compressor discharge line (13) connecting the engine intake and the compressor outlet (32), wherein a

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first end (27) of the recirculation line (18) is connected to the compressor discharge line (13) and a second end (28) of the recirculation line is in fluid communication with the compressor air inlet (23), and wherein the air cooling device (50) is disposed between the first end (27) and the second end (28) of the recirculation line (18).

- 10. The system of Claim 1, further comprising a compressor inlet line (12) connected to the compressor air inlet (23), the recirculation line (18) being connected to the compressor inlet line (12), and further comprising an air cleaner (49) connected to the compressor inlet line (12) downstream of the recirculation line (18) and compressor inlet line (12) connection, and wherein the air cleaner (49) is also configured to mix recirculated and inlet air.
- 11. The system of Claim 10, further comprising a compressor discharge line (13) connecting the engine intake and the compressor outlet (32), wherein the recirculation line (18) is connected to the compressor discharge line (13).
- 12. The system of Claim 11, further comprising a second air cooler (19) connected in fluid communication with the compressor discharge line (13) downstream of the recirculation line (18) and compressor discharge line (13) connection.
- recirculation line (17) connected to the compressor discharge line (13) downstream of the connection between the recirculation line (18) and compressor discharge line (13).
- 14. The system of Claim 13, further comprising an exhaust gas cooling device (42) connected to the exhaust gas recirculation line (17).
- 15. The system of Claim 14, further comprising a second air cooling device (19) connected to the compressor discharge line (13) downstream of the recirculation line (18) first end (27) and compressor discharge line (13) connection

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and upstream of the exhaust gas recirculation line (17) and compressor discharge line (13) connection.

16. A method of actively controlling compressor surge in an engine system wherein air is compressed in a compressor (11) and supplied to an intake of an internal combustion engine (14), said surge controlling method comprising the steps of:

supplying air to a compressor inlet (23) of the compressor (11); compressing the air in the compressor;

discharging the compressed air from the compressor through a compressor discharge line (13) to the intake of the internal combustion engine (14);

providing a recirculation line (18) connecting the compressor discharge line (13) to the compressor inlet (23);

providing a controllable recirculation valve (22) in the recirculation line (18) for controlling an amount of flow through the recirculation line;

opening the valve (22) and recirculating compressed air from the compressor discharge line (13) to the compressor inlet (23) when the engine (14) is operating below a threshold engine speed, and maintaining the valve (22) closed so as to prevent recirculation when the engine (14) is operating above said threshold engine speed; and

cooling the recirculated air prior to delivering the recirculated air to the compressor inlet (23).

- 17. The method of Claim 16, further comprising mixing the cooled recirculated air with the air being supplied to the compressor inlet (23) such that flow conditions entering the compressor (11) are more uniform than would exist without said mixing.
- 18. The method of Claim 16, wherein an amount of the valve opening (RVO) of the recirculation valve (22) is a function of the engine speed and the outlet air pressure of the compressed air discharged from the compressor (11).

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19. The method of Claim 18, wherein the amount of valve opening (RVO) is controlled according to the equation:

RVO = A/Ne + B/P2C

wherein A and B are predetermined constants, Ne is the engine speed and P2C is the outlet air pressure.

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Form PCT/RO/101 (second sheet) (June 2003)

See Notes to the request form